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AIRCRAFT RESEARCH AND DEVELOPMENT UNIT EDINBURGH (AUS--ETC F/8 4/2  
MEAN ATMOSPHERIC CONDITIONS - AUSTRALIAN TROPICAL OPERATING CON--ETC(U)  
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DEPARTMENT OF DEFENCE

ROYAL AUSTRALIAN AIR FORCE

AIRCRAFT RESEARCH AND DEVELOPMENT UNIT

EDINBURGH, SOUTH AUSTRALIA

TECHNICAL NOTE AERONAUTICAL NO 72

MEAN ATMOSPHERIC CONDITIONS - AUSTRALIAN TROPICAL OPERATING CONDITIONS

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The ARDU mean tropical atmosphere differs significantly from the ICAO standard atmosphere and is based upon data gathered prior to 1965.

More recent data have been considered in a reassessment of the validity of the ARDU atmosphere. The new data support the retention of both the ARDU tropical atmosphere and the ICAO atmosphere to describe mean conditions in their respective regions of application. It is recommended, however, that where extreme operating conditions for the Australian region are required, reference should be made to DEF(AUST) 5168 Part II - Air Operations.

## AIRCRAFT RESEARCH AND DEVELOPMENT UNIT

MEAN ATMOSPHERIC CONDITIONS - AUSTRALIAN TROPICAL OPERATING CONDITIONS

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SUMMARY

The ARDU mean tropical atmosphere differs significantly from the ICAO standard atmosphere and is based upon data gathered prior to 1965.

More recent data have been considered in a reassessment of the validity of the ARDU atmosphere. The new data support the retention of both the ARDU tropical atmosphere and the ICAO atmosphere to describe mean conditions in their respective regions of application. It is recommended, however, that where extreme operating conditions for the Australian region are required, reference should be made to DEF(AUST) 5168 Part II - Air Operations.

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- 2.1 ARDU Mean Tropical Atmosphere

ANNEXES

- A. Mean and Extreme Temperatures for Australian Operating Conditions, after ARDU TS 1481
- B. High and Low Temperatures for the Australian Region (DEF(AUST) 5168 Pt II - Air Operations)

MEAN ATMOSPHERIC CONDITIONS - AUSTRALIAN TROPICAL OPERATING CONDITIONS

1. INTRODUCTION

1.1 Under Reference A, Aircraft Research and Development Unit (ARDU) undertook to

- a. collate all information available on the original data base and analysis method used to define the current ARDU mean tropical atmosphere;
- b. liaise with appropriate agencies (eg DRCS, Bureau of Meteorology) to assess the validity of the ARDU atmosphere for Australian tropical operating conditions; and
- c. define a more accurate mean atmosphere for Australian tropical operations if necessary

2. DATA SOURCES

2.1 The ARDU Mean Tropical Atmosphere

2.1.1 The ARDU mean tropical atmosphere, originally published as Figure 1 of Reference B, is shown at Annex A. This atmosphere was compiled from data pre-dating December 1963. A thorough search failed to establish any trace of the data source, which is not surprising since the work was carried out over seventeen years ago. Reference B states that the ARDU mean tropical atmosphere was found satisfactory for Sabre operations at Darwin, Butterworth and Singapore.

2.1.2 Since the ARDU atmosphere has been widely used in the past and may continue to be used in the future, it is important that it be clearly defined. Table 2.1 defines five key points on the temperature profile between sea level and 70,000 ft. Temperatures at intermediate altitudes are determined by linear interpolation.

TABLE 2.1 - ARDU MEAN TROPICAL ATMOSPHERE

Altitude (feet x 1,000)	Temperature (°C)
0	27.5
25	-20
45	-68
54	-80
70	-60



## 2.2 The ICAO Standard Atmosphere.

2.2.1 Also included at Annex A are the ICAO standard temperature profile (Reference C) and ICAO  $\pm 10^{\circ}\text{C}$  curves, as well as maximum and minimum boundaries for temperatures likely to be encountered in the Australian region.

## 2.3 Current Australian Meteorological Data.

2.3.1 The Bureau of Meteorology is the prime Australian agency concerned with the collection and archival of meteorological data in the Australian region.

2.3.2 The Bureau, from time to time, publishes meteorological summaries, of which Reference D is an example. Reference D tabulates statistics of upper wind and radiosonde data for 27 stations throughout Australia and for stations at Cocos Island, Honiara, Casey, Davis, Macquarie Island and Mawson. Other statistics for these and other stations are available from the Bureau on request.

2.3.3 Such data are now routinely stored on computer tapes enabling efficient sorting techniques and modern statistical procedures to be readily applied to large quantities of data.

2.3.4 Timely preparation of a new Defence Standard (Reference E), based on current Bureau of Meteorology records, for the whole of the Australian region, has obviated the need for a direct referral to those records for this Technical Note. Reference E specifies the mean and extreme climatic factors affecting the design of military materiel. The data are aggregated for the whole of Australia with a separate section covering the Antarctic region; but, where particular regions have a strong influence on some of the data, note has been made of this.

2.3.5 Mean high and mean low temperature profiles, and 1% risk high and 1% risk low temperature profiles from Reference E are shown at Annex B.

## 3. DATA COMPARISONS

3.1 As shown at Annex A, the ICAO standard atmosphere temperature profile varies linearly with height from  $+15^{\circ}\text{C}$  at sea level to  $-57^{\circ}\text{C}$  at 36,000 ft and, thereafter, remains constant to 70,000 ft. The ARDU mean tropical atmosphere is 12 to  $15^{\circ}\text{C}$  warmer up to 35,000 ft but continues to decrease in temperature to  $-80^{\circ}\text{C}$  at 54,000 ft, then increases in temperature to  $-60^{\circ}\text{C}$  at 70,000 ft.

3.2 The significant differences between the two profiles are attributable to latitude. The ARDU profile is based upon tropical data, while the ICAO profile represents latitude  $45^{\circ}\text{N}$ .

3.3 Since large scale meteorological phenomena tend to be similar on both sides of the equator, the ICAO standard atmosphere can be expected to exhibit the major trends encountered over southern Tasmania at latitude  $45^{\circ}\text{S}$ . Inspection of Annex B demonstrates this to be the case.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Although the original data source for the ARDU mean tropical atmosphere has not been determined, the atmosphere is consistent with current Bureau of Meteorology records which form the basis of Reference E.

4.2 The ICAO standard atmosphere used for comparison in Annex A is based upon latitude 45°N and is inappropriate for use in tropical regions.

4.3 Both atmospheres are consistent with the more detailed bounds tabulated in Reference E and shown at Annex B.

4.4 It is still appropriate to use the ARDU atmosphere and the ICAO atmosphere to represent mean operating conditions at the appropriate latitudes. However, for the representation of extreme operating conditions Reference E should be followed.

5    REFERENCES

- A.    ARDU/2535/4/72/Tech 11 . 29 August 1979
- B.    ARDU Report TS 1481, October 1964
- C.    US Standard Atmosphere, U.S. Govt Printing Office, Washington, DC. 1962
- D.    J.V Maher and D.M Lee.    Upper Air Statistics Australia Surface to 5 mb 1950 to 1975    Australian Govt Publishing Service. Canberra 1977
- E.    DEF (AUST) 5:68 Part II - Air Operations - Preliminary Draft, July 1984

MEAN AND EXTREME TEMPERATURES FOR  
AUSTRALIAN OPERATING CONDITIONS, AFTER ARDU TS 148.

NOTE

THIS GRAPH IS BASED ON DATA AVAILABLE  
AT ARDU IN DECEMBER 1963

ARDU MEAN TROPICAL ATMOSPHERE  $-10^{\circ}\text{C}$

ICAO STANDARD ATMOSPHERE  $-10^{\circ}\text{C}$

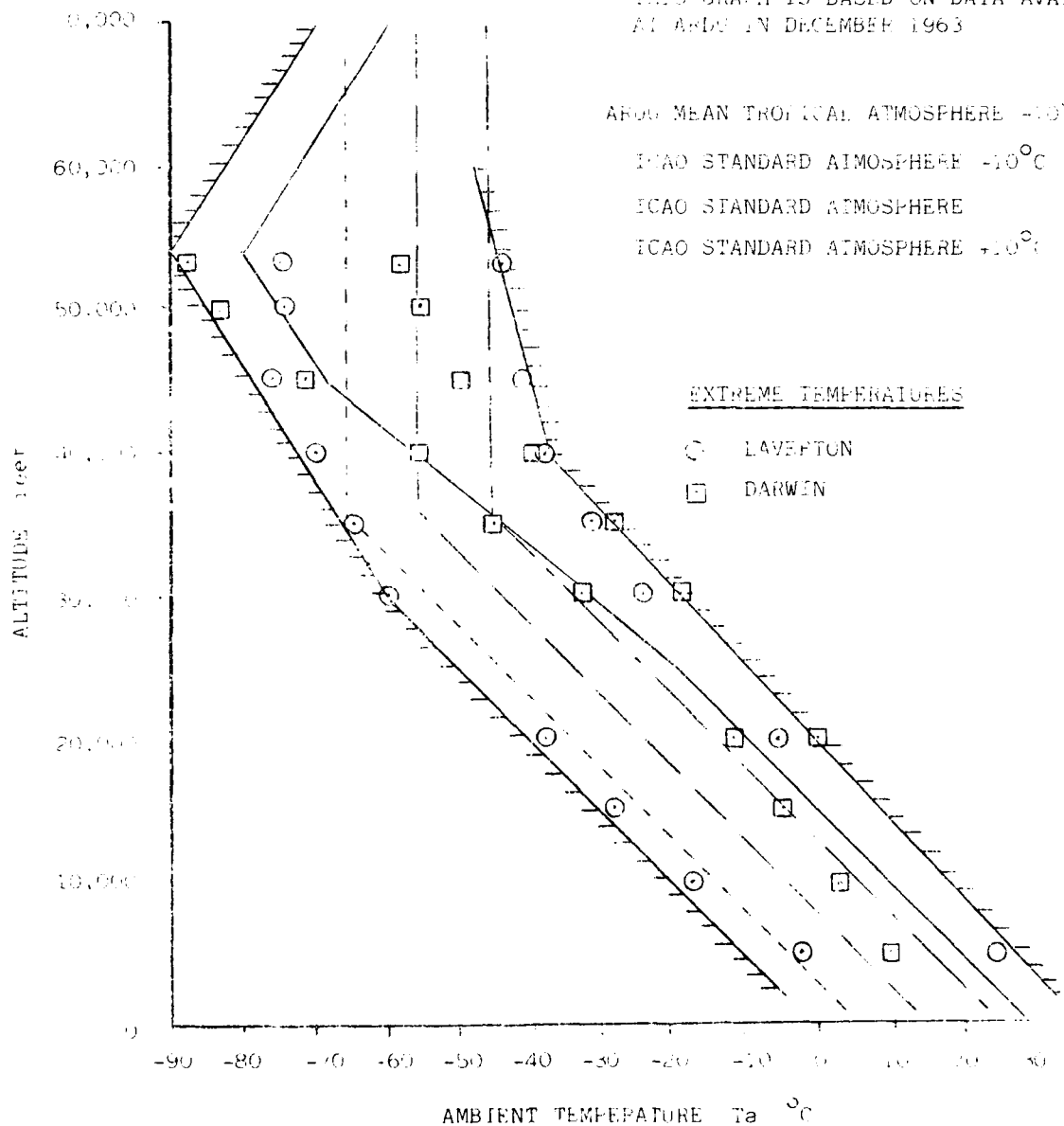
ICAO STANDARD ATMOSPHERE

ICAO STANDARD ATMOSPHERE  $+10^{\circ}\text{C}$

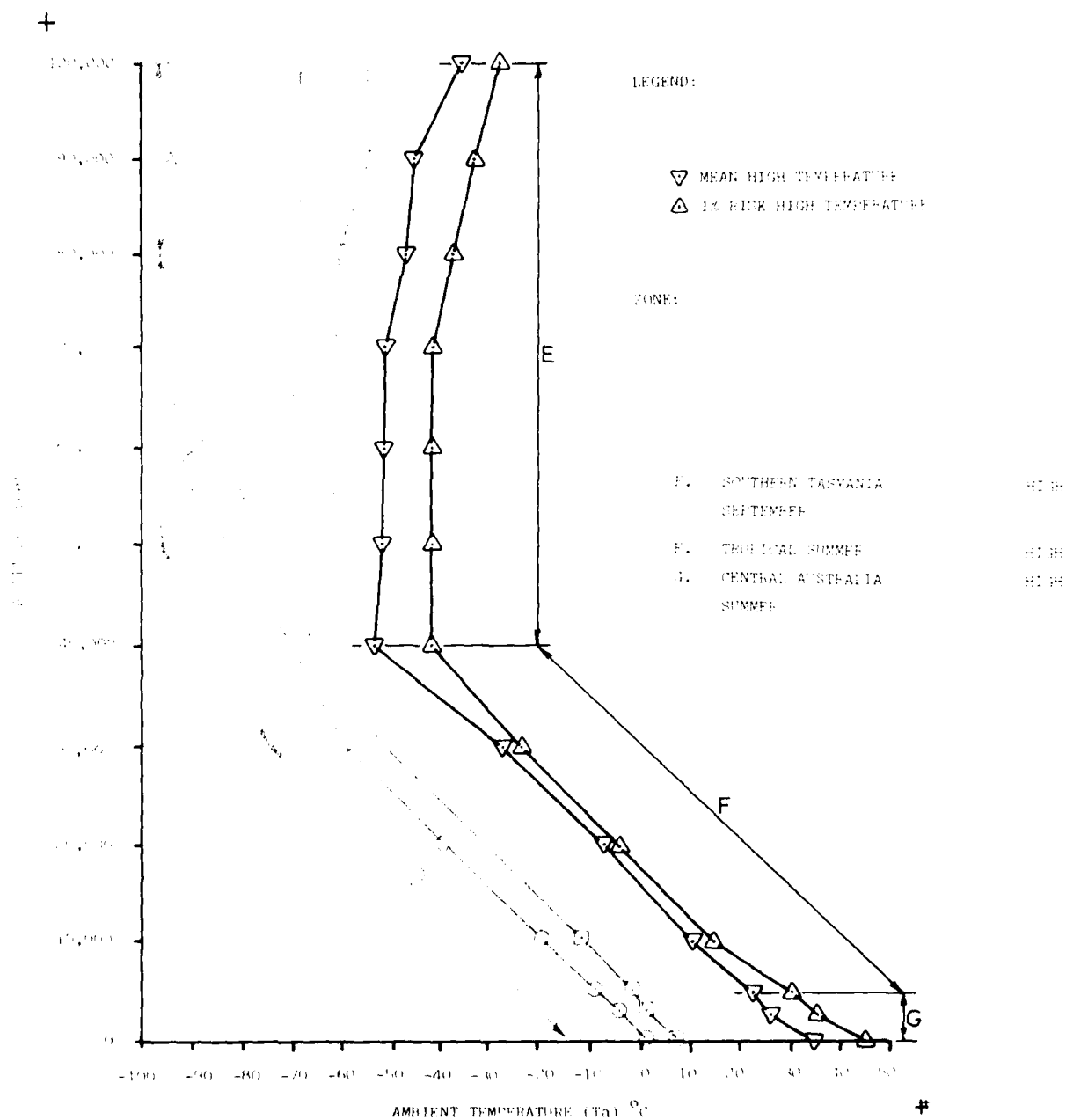
EXTREME TEMPERATURES

○ LAVERTON

□ DARWIN



HIGH AND LOW TEMPERATURES FOR THE AUSTRALIAN REGION  
(DEF(AUST) 5168 PT II - AIR OPERATIONS)



## AIRCRAFT RESEARCH AND DEVELOPMENT UNIT

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## MEAN ATMOSPHERIC CONDITIONS - AUSTRALIAN TROPICAL OPERATING CONDITIONS

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